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ARMORED MEDICAL RESEARCH LABORATORY

FORT KNOX, KENTUCKY

INDEXED

Final Report

On

PROJECT NO. 41 - PHYSIOLOGICAL AND OPERATIONAL CHARACTERISTICS
OF TANK T25E1.

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Project No. 41

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1. PROJECT NO. 41 - Physiological and Operational Characteristics of Tank T25E1. Final Report.

a. Authority: 2nd Ind. by Office of The Surgeon General to letter, Office of Chief of Ordnance, Washington, D. C. File 00470.8/1442 SPOTT dated 14 June 1944. Subject: Service Test of Medium Tank T25E1 by Armored Medical Research Laboratory.

b. Purpose: To appraise the pilot model of Tank T25E1 as to physiological characteristics, with special reference to crew efficiency and comfort, adequacy of ventilation for control of gun fumes and other requirements, effectiveness of general vision, fire control.

2. DISCUSSION:

a. Results of investigation of the gun fume hazard in subject tank together with recommendations for improvement of ventilation were presented in the First Partial Report, dated 19 July 1944. The present report deals with fire control, general vision, hatchways, seats, internal stowage, location of controls, etc. The earlier findings on ventilation are summarized and further discussion of ventilation from the standpoint of dust and heat is presented.

b. It is recognized that the T25E1 does not represent the proposed production vehicle and that certain of the points of discussion with respect to this vehicle will not apply to the T26E1 or its production counterpart.

c. The findings of this study are presented in the Appendix.

3. CONCLUSIONS:

a. Seats: Height adjustment of the bow seats and the commander's seat are not in accordance with requirements for 90% of armored personnel. Other deficiencies are listed in the Appendix.

b. Hatchways: Escape hatches require improved unlocking device to insure rapid opening in an emergency. Lock on bow hatches and commander's hatch interfere with certain operations and require improvement.

c. Accelerator pedal: Foot clearance is not adequate and toe-in position of foot is fatiguing.

d. Turret lock is inconveniently located for operation by gunner. Commander's turret control interferes with manual traverse operation by gunner.

e. Engine compartment door handles are improperly designed and increase accident hazard in opening.

f. Stowage and handling of ammunition are unsatisfactory.

g. Provisions for general vision from the tank are not adequate for close country operation where maximum near ground vision is required for tank protection. The driver's main periscope is unsuitable owing to its restricted field of view and the inaccessible position of the secondary periscope renders it of little value.

h. Fire control provisions are not adequate to permit full utilization of the 90 mm gun.

i. Ventilation: The improved ventilation at 1000 cfm is adequate for control of gun fumes and heat. The dust exposure is not increased over that of the M4 Tank.

4. RECOMMENDATIONS:

I SEATS

a. Change height adjustment of bow seats and commander's seat to give four positions 29, 30, 31 and 32 inches below center of periscope window for buttoned-up operations.

b. Increase height, width and curvature of seat back for bow seats.

c. Paint seats with care so that adjusting mechanism and other moving parts will work satisfactorily.

d. Provide proper stowage facilities for gunner's seat back and for loader's seat.

II HATCHWAYS

a. Provide improved locking and opening device for escape hatches to insure rapid use in emergency.

b. Provide more rapid action on locking device for bow hatches.

c. Eliminate interference with use of periscope and periscopic binoculars by commander's hatch lock.

d. Provide drain in splash deflector around bow hatches.

III CONTROLS

a. Re-locate accelerator pedal $1-1\frac{1}{2}$ " lower and change angle to give 5 to 10 toe-out position. Provide heel rest for left foot.

b. Re-locate turret lock for more convenient use by gunner.

c. Turn commander's turret control handle in along turret wall to remove interference with gunner's arm.

d. Eliminate interference now caused by piping with elevation hand wheel operation.

e. Provide thin padding under traverse gear housing to protect gunner's knee.

f. Improve engine door handles to reduce possible accident hazard in opening.

IV GENERAL VISION

a. Immediate consideration be given to the development of an improved vision cupola with less limited ground vision. In new design provide for hatch inside rotor as previously recommended, rather than with rotor in the hatch.

b. Provide rhombic vision units in turret wall for loader, in order to secure near ground vision.

c. Provide driver with wide field vision units (blocks or rhombs) possibly supplemented by periscope for cross-tank vision.

V FIRE CONTROL

a. Provide for mounting and linkage for M10 periscopic sight and to this end:

- (1) Move lift eyes on gun shield
- (2) Round corner of gun shield
- (3) Lower armor around periscope
- (4) Crown armor up behind periscope

b. Bulge turret side wall to give adequate lateral clearance.

c. Provide rangefinder in order to offset present limitation caused by obscuration from gun blast.

VI VENTILATION

a. Reduce noise level of 1000 cfm fan.

b. Relocate fan, if possible, to permit cross passage by bow crew members.

NOTE: The following recommendation was set forth by Headquarters Armored Center, Kent C. Lambert, Colonel, Acting Chief of Staff: "Recommend no action be taken on this report, inasmuch as the T25E1 tank is no longer being considered for production."

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#1 - Appendix

#2 - Figs. 1 thru 4

1. SEATS:

a. Driver Seat can be adjusted in only two positions for buttoned-up driving - 29" and 30½" from bottom of seat to center line of main periscope. Four positions at 29, 30, 31 and 32 inches below center of periscope window was recommended in AMEL report on Seat Design for M4 Tanks, dated 5 March 1943. The seat back should be wider and higher and requires more curvature for better support. The seat adjustment handle interferes with the right steering lever. Attention is again called to the manner in which careless application of paint clogs moving parts of seats.

b. Turret Seats: The commanders seat is adjustable in position 30, 31, 32, 33 and 34 inches from center line of periscope in addition to stop for upper position. It is recommended that lower stops be located at 29, 30, 31 and 32 inches from center of periscope window and that upper position stop be retained. The loader's seat is removable but the lugs for holding in stowed position were not provided. A stowage rack is required for gunner's seat back when not in use.

2. HATCHWAYS:

a. Escape hatches can be opened only with the aid of a bar or other tool. If an escape hatch is to serve its purpose it must be easily opened. An escape hatch which cannot be opened in a matter of seconds leads to a sense of false security. An auxiliary lever at right angles to main lever would probably correct this deficiency. Otherwise, a completely new design or major modification will be necessary.

b. Bow hatch lock bolt scraped along bracket when being engaged. The present screw closure is too slow to operate for rapid exit. A quick-opening lock is recommended. The splash deflector around the driver and assistant driver's hatch slopes down toward the front and makes a basin for the accumulation of water, sand or ice which will probably interfere with the operation of the hatch and cause leakage of water into the driver's compartment. A drain at the lowest point is recommended which will also serve as a flush for sand and dust.

c. Commander's hatch: The lock interferes with use of periscopic binoculars and causes hand injury when operating the binoculars.

3. CONTROLS:

a. Accelerator: Insufficient distance from heel rest to front armor for men wearing large size arctics. This can be corrected by lowering pedal 1 to 1½ inches. The present toe-in attitude required by the vertical side of the accelerator pedal is tiring. A toe-out angle of 5° to 10° would give more natural foot and leg position and provide greater comfort. A heel rest is required for the left foot and should be so located that the siren can be operated by simple rotation of the foot.

b. Turret: The turret lock is inconveniently located for operation by the gunner, especially when the commander is seated. The commander's turret control extends outward from the turret wall and interferes with the gunner's arm when operating manual traverse. It should be turned slightly inward toward the front of the turret. The piping directly in front of the elevating hand wheel should be moved forward 2 inches to eliminate interference with the gunner's hand when elevating the gun. Thin padding under the traverse bear housing where there is slight clearance is required to protect gunner's knee. Fasteners for the floor plates were bent and difficult to work. It is evident that an improved design is required.

c. Engine compartment: Door handles are offset from edge, thus requiring a change of purchase after opening the door approximately 75°. The weight of the doors, together with the fact that they are not counterbalanced, makes opening a hazardous operation. Swinging handles allowing complete opening without change of purchase and torsion bar loading are recommended.

4. STOWAGE:

a. The binocular box on the turret wall interferes with commander's right leg. Convenient, out-of-the-way stowage should be provided; since, during combat the commander generally wears his binoculars, the stowage box need not be immediately accessible.

b. The awkwardness of getting at ammunition indicates that the whole problem of stowage and handling of ammunition requires further study. Since the T25E1 does not represent the proposed production vehicle, no study has been made of this difficult problem. The present situation in this respect indicates the weakness of design procedure which calls for working out stowage arrangements after the basic hull and turret design have been fixed.

5. GENERAL VISION:

a. Commander: The limits of ground vision provided through the periscope (by rotation) and through the vision cupola are shown in Fig. 1. The limitation in vision to the left and to the rear are clearly illustrated. The vision to the right flank is only fair. The vision blocks were found to be defective in that there were many internal bubbles which appeared to increase with age. The surface of one block was destroyed over a large area by grinding. No padding for head protection is provided. The ball race was found to jam quickly with dirt and grit, especially when operating with hatch open. This deficiency which has been previously pointed out, greatly reduces the value of the rotating periscope or periscopic binoculars.

b. Loader: The limits of ground vision provided through the loader's periscope are shown in Fig. 2. The closeness of vision to the tank is not greatly improved over that of the commander. Since the loader is the only crew member who is in a position to obtain close vision on the left, improvement is required. This can be obtained by the installation of rhombic vision units in the side armor.

c. Driver: Limits of ground vision are shown in Fig. 3. The M6 periscope is unsuitable for driver vision owing to its restricted field of view. Furthermore, the driver cannot conveniently make the continual re-adjustments necessary to gain even partial knowledge of the ground to be traversed. The secondary periscope is too inaccessible to supplement vision through the main instrument. The rib which projects down around the inside of the hatch and the projection of the turret ring bearing interfere with the driver's head movement and prevents his effective use of the secondary periscope.

d. Combined Vision: Immediate and close-in ground vision surrounding a tank becomes increasingly important when operating in terrain which provides close infantry cover. The overall limits of ground vision provided in the T34, shown in Fig. 4, fail to provide this necessary close-in vision. The vision cupola is especially lacking in downward vision and the raised ring of the loader's hatch obstructs cross-tank vision from the cupola. The large flat turret top sets a limit to downward vision from any vision device placed low in the rood.

6. FIRE CONTROL

a. M8 Periscope

- (1) Field of view of the 1.88 power telescopic sight is inadequate
- (2) Field of view of the unit power vision is inadequate
- (3) Low precision of periscope linkage results in a sloppy movement in relation to gun.

b. Telescope M71C

- (1) Lateral clearance for left-eyed gunner lacking when gun is depressed beyond 6° and helmet not worn; when helmet is worn, the limit is 4° .
- (2) Hand interference at elevation wheel occurs when the gun is elevated beyond 16° .
- (3) Long eye-to-trunion distance prevents the combined use of the periscopic sight and telescope when the gun is elevated beyond 10° .
- (4) Head-rest adjustment is difficult to make even when using a wrench. The head rest was found to be inadequate even when properly adjusted.

c. Lack of rangefinder - Owing to the prolonged obscuration by gun blast, sensing of fire is difficult and even impossible under certain conditions. This renders the gun almost useless unless a rangefinder is provided to increase probability of hit from first shot. This deficiency requires solution (rangefinder, muzzle brake, long primer ammunition) before the advantages of the 90 mm gun can be realized.

7. VENTILATION

a. Control of gun fumes - The First Partial Report, dated 19 July 1944, recommended the installation of a 1000 cfm fan for the control of gun fumes. Further observation have been made with respect to the dust and heat problems associated with this change in ventilation.

b. Dust exposure - Comparative measurements were made of the dust exposure in the T25E1 equipped with the axial flow, 1000 cfm, fan and in the standard M4A3 tank. Both tanks were fitted with dust skirts. The driving range was dry and extremely dusty. Weather was clear and cool with variable winds of 2 to 7 mph. The driving course was oval in shape and approximately 400 yards in circumference. Tank speed averaged 4 mph for both vehicles which were operated buttoned-up. Dust samples were collected under two conditions: (1) while the test tank was operating alone and (2) while following, at a distance of 10 to 30 yards, an M4 tank without dust skirts. The T25E1 and M4A3 tanks were alternated in the test runs, each consisting of 3 to 5 circuits of the course. Dust samples were collected by MSA Midget Impinger at the breathing zone of the assistant driver and the opinions of the crew members as to relative dustiness recorded.

Results of dust counts are presented in Table 1

TABLE 1

COMPARATIVE DUST CONCENTRATIONS IN BOW
T25E1 WITH 1000 CFM FAN VS STANDARD M4A3

| TEST CONDITION | TEST TANK | |
|------------------|----------------|----------|
| | M4A3 | T25E1 |
| Operating Alone | 253, 435 | 75, 215 |
| Trailing M4 Tank | 638, 423, 1130 | 348, 382 |

These comparative data indicate high dust concentrations in both cases but no worse condition in the T25E1 despite the localized air intake in the bow. Opinions of crew and test observers were variable as to relative dustiness of the two vehicles, leaving the impression that there was no striking difference between them. Complaints of the turret crew members were somewhat more frequent in the M4A3 and, conversely, of the bow members in the T25E1.

c. Heat. No tests were run to determine the heat load in the T25E1 with modified ventilation. However, in another field test, conducted at Camp Polk, La., it was found that a minimum rate of positive ventilation of 600 cfm in the M4A3 tank was adequate to keep the tank atmosphere within acceptable limits with ambient temperatures up to 100°F, dry bulb and 78°F, wet bulb.

d. Fan location and noise.- Frequent complaints of the high noise level of the fan were noted. Objections were also raised to its location between the two bow crew members since it prevents passage from one side to the other. This latter objection is important since both bow hatches cannot be opened when the turret is rotated a few degrees to right or left of 12 o'clock. It is understood that Ordnance is undertaking to reduce the noise level of the fan. In addition to this improvement, consideration should be given to its relocation to free the passage between the bow compartments.

FIG.1
LIMITS OF COMMANDERS GROUND VISION
THROUGH PERISCOPE AND VISION CUPOLA
T 25 EI TANK



FIG.1

FIG. 2
LIMITS OF LEADERS GROUND VISION
T 25 EI TANK

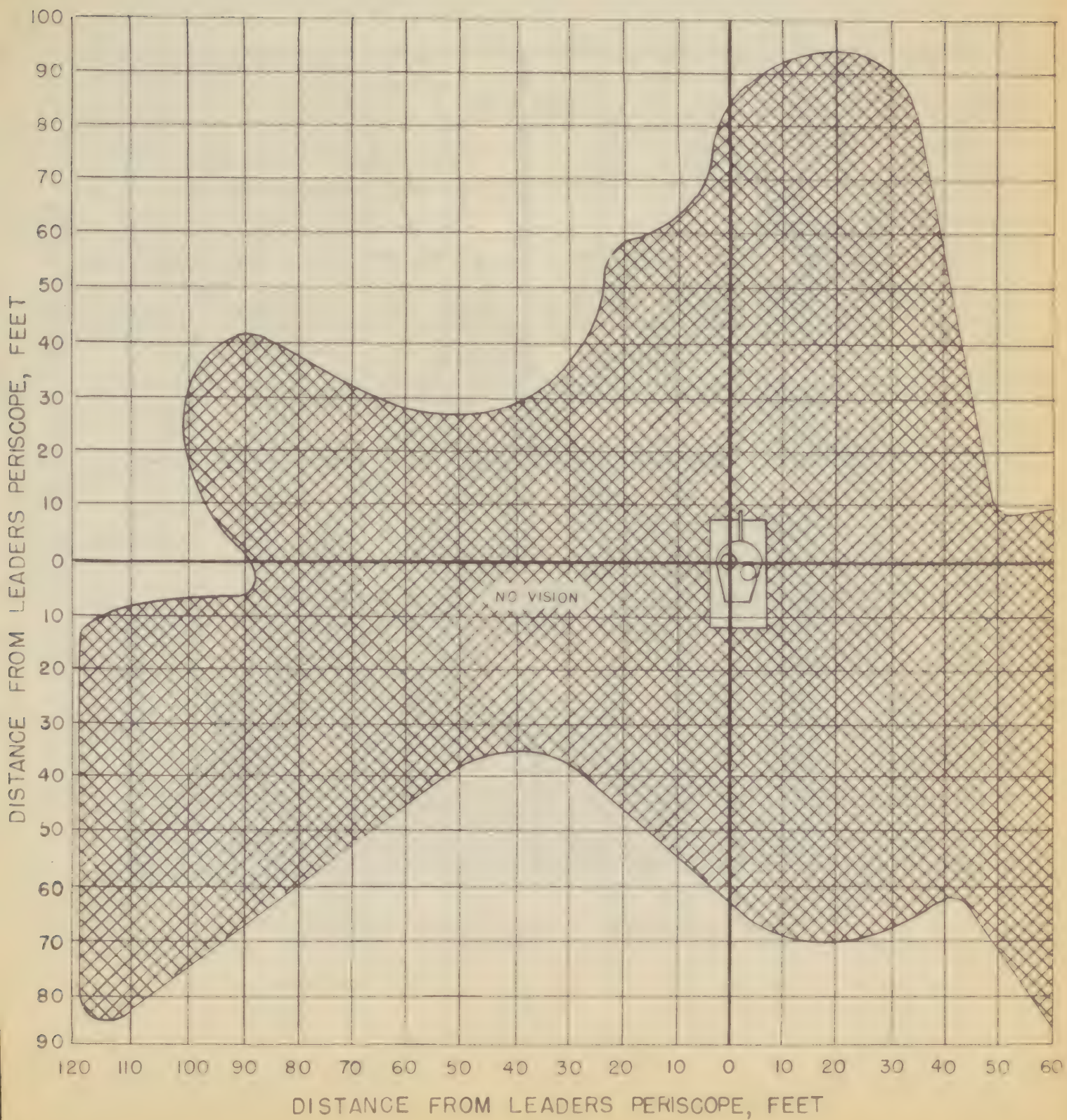


FIG 2

FIG. 3
LIMITS OF DRIVERS GROUND VISION
T25 EI TANK

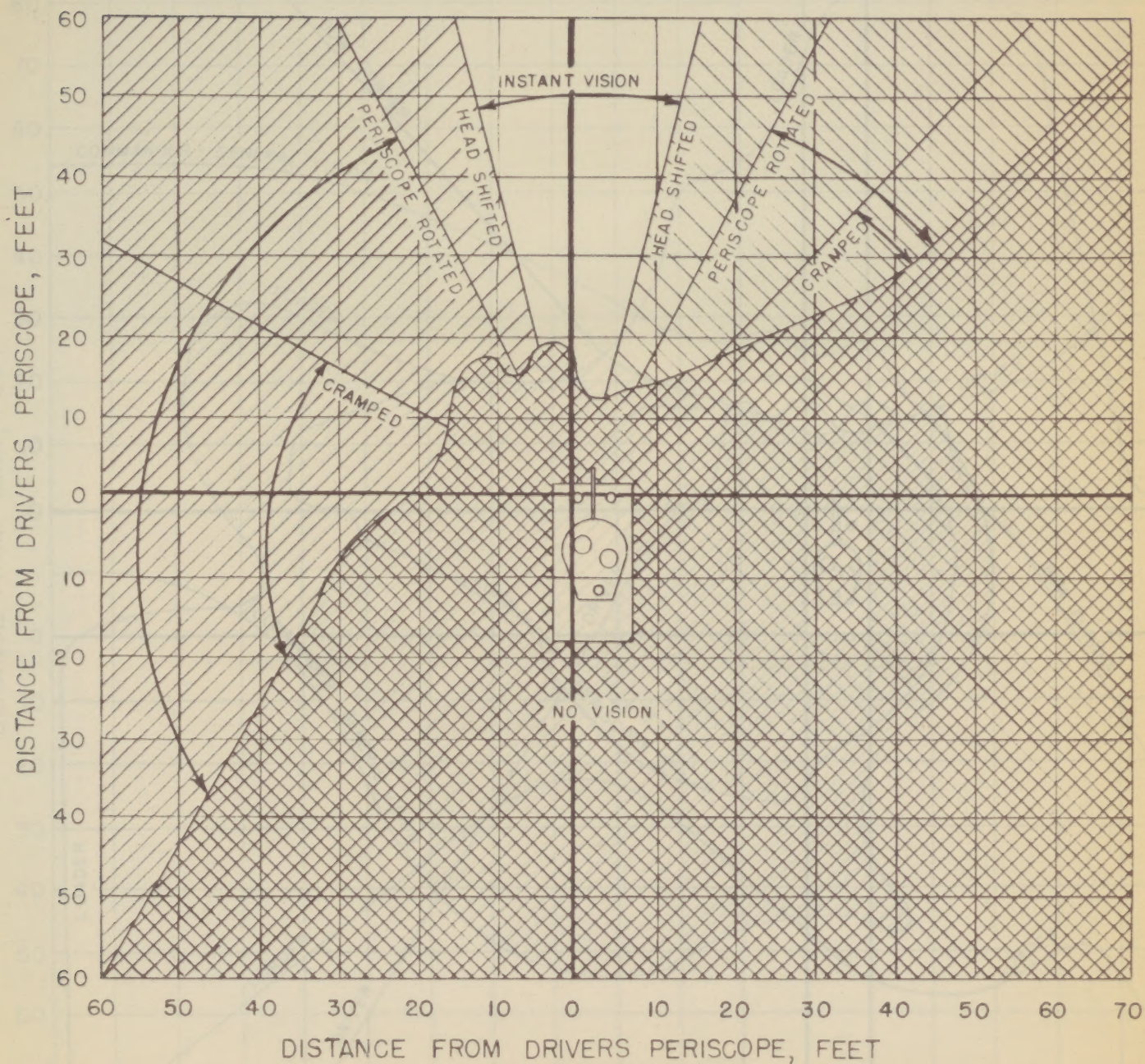


FIG. 3

FIG 4

OVERALL GROUND VISION LIMITS

(ALL CREW MEMBERS)

T 25 E1 TANK

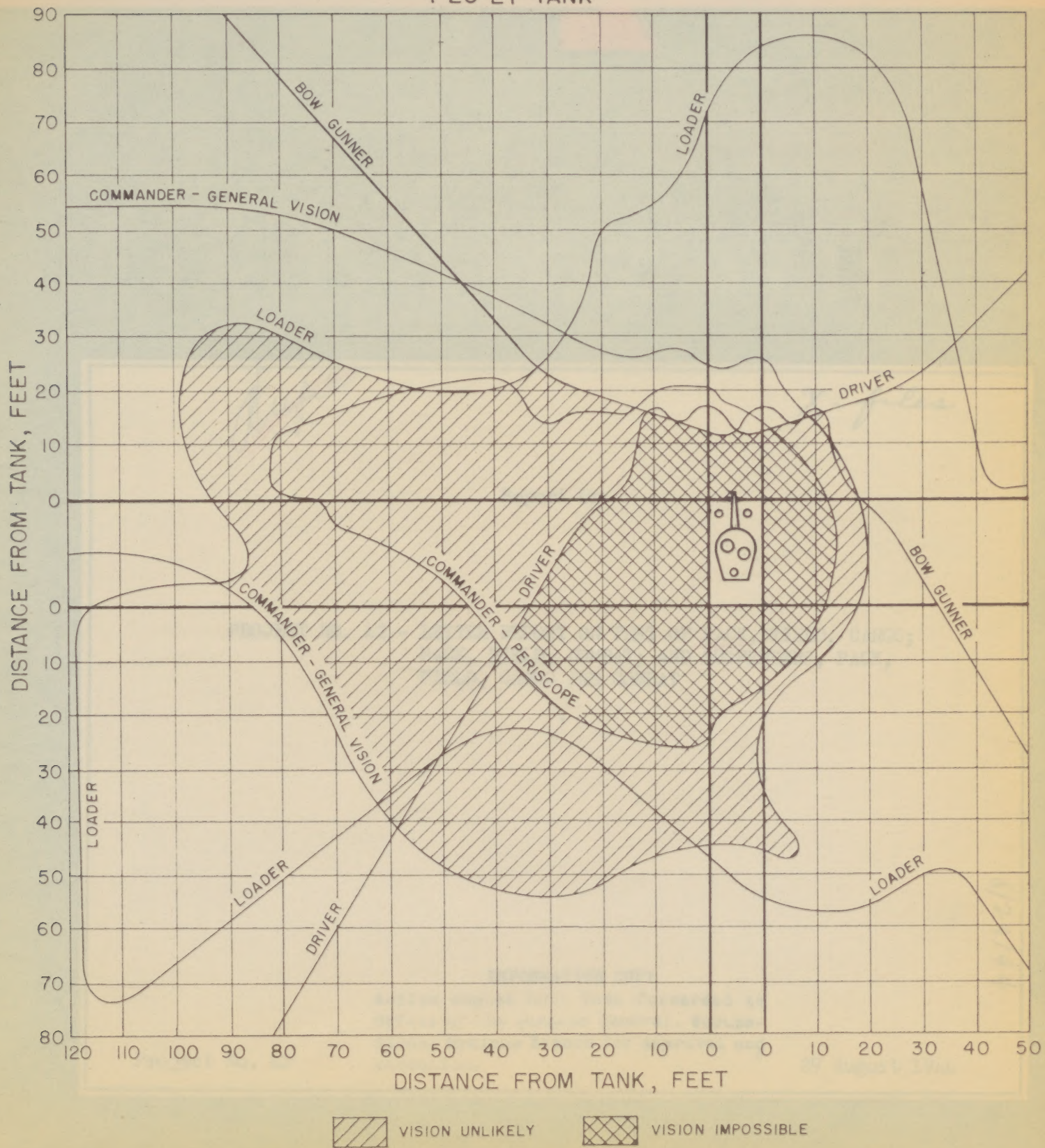


FIG. 4

